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ABSTRACT

This report presents evaluative information concerning Project Math and Science, a New York City program that provided instruction in English as a second language (ESL), native language arts (NLA), and bilingual instruction in the content areas of mathematics and science. The project also provided teachers of participating students (630 mostly Chinese Speaking) with extensive staff-development workshops and activities, funds for attendance at conferences, and tuition reimbursement for teachers who took pertinent courses (including computer science). The project had an active parental component that encouraged parents' active participation in their children's education. Data show that the project met its three ESL objectives, two of three mathematics objectives, and one of two science objectives. The project also met its objective for career awareness, three staff-development objectives, and one of two parental-involvement objectives. It did not meet its objective for the development of higher-order thinking skills related to mathematics. Appendices contain a list of instructional materials, class schedules, and Likert Scales used in the evaluation. The report ends with conclusions and recommendations. (GLR)

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Chinese Bilingual Mathematics and Science Program
Community School District 2
Transitional Bilingual Education Grant T003A10197
FINAL EVALUATION REPORT
1992-93

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Chinese Bilingual Mathematics and Science Program
Community School District 2
Transitional Bilingual Education Grant T003A10197
FINAL EVALUATION REPORT
1992-93

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EXECUTIVE SUMMARY

The Chinese Bilingual Mathematics and Science Program (Project Math and Science), was an Elementary and Secondary Education Act (E.S.E.A.) Title VII-funded project in its second year in 1992-93. The project functioned at P.S. 1, P.S. 2, P.S. 42, P.S. 124, and P.S. 130 in Community School District (C.S.D.) 2, Manhattan. In the year under review, the project served 630 mostly Chinese-speaking students who scored at or below the 40th percentile on the Language Assessment Battery and were thus categorized as being of limited English proficiency (LEP). The project provided instruction in English as a second language (E.S.L.), native language arts (N.L.A.), and the content areas of mathematics and science, which were taught bilingually.

The project provided teachers of participating students with extensive staff development workshops and the activities, funds for attendance at conferences, and tuition reimbursement for teachers who took pertinent courses (including computer science). The project also provided $300.00 for each teacher of kindergarten through third grade to purchase science and mathematics materials.

Project Math and Science had an active parental component with many activities and workshops that encouraged parents' active participation in their children's education. Project staff led a parent's group to a State Association for Bilingual Education (SABE) conference. The project also developed, translated, and disseminated a parent newsletter.

Project Math and Science met its three E.S.L. objectives, two of three mathematics objectives, and one of two science objectives. The project also met its objective for career awareness, three staff development objectives, and one of two parental involvement objectives. The project did not meet its objective for the development of higher order thinking skills related to mathematics. OREA could not evaluate one objective for the development of science skills or the parental attendance objective because the project did not provide the necessary data.

The conclusions, based on the findings of this evaluation, lead to the following recommendations:

- Explore additional techniques to increase students' acquisition of skills in mathematics, possibly by expanding peer tutoring and enrichment programming.

- Provide OREA with the attendance data necessary to fully evaluate all objectives.

ACKNOWLEDGMENTS

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I. INTRODUCTION

In 1992-93, the Chinese Bilingual Mathematics and Science Program (Project Math and Science) was in its second year of funding as an Elementary and Secondary Education Act (E.S.E.A.) Title VII project.

PROJECT CONTEXT

The project operated at five sites in Community School District (C.S.D.) 2 in Manhattan: P.S. 1, P.S. 2, P.S. 42, P.S. 124, and P.S. 130. The student population in C.S.D. 2 was 34 percent Asian-American, 30 percent European-American, 22 percent Latino, and 15 percent African-American. Fifty-four percent of the students came from low-income families as indicated by their eligibility for the free-lunch program. This percentage was much higher at the project school sites because of the way the district is zoned.

Composition of the student body at each of the five project sites was as follows:

At P.S. 1, of a total of 679 students, 70 percent were Asian-American, 16 percent were Latino, 13 percent were African-American, and 1 percent were European-American. Thirty percent (207) of the total number were of limited English proficiency (LEP), and 89 percent came from low-income families.

At P.S. 2, of 829 students, 80 percent were Asian-American, 13 percent were Latino, 6.5 percent were African-American, and 0.5 percent were European-American. Twenty-eight percent (232) of the total number were LEP, and 92 percent came from low-income families.

At P.S. 42, of 839 students, 80 percent were Asian-American, 16 percent were Latino, 2 percent were African-American, and 2 percent were European-American*. Forty percent (336) were LEP, and 91 percent came from low-income families.

At P.S. 124, of 1,136 students, 91 percent were Asian-American, 2.5 percent were Latino, 4.5 percent were European-American, and 2 percent were African-American*. Twenty-nine percent (330) were LEP, and 69 percent came from low-income families.

At P.S. 130, of 918 students, 91 percent were Asian-American, 7 percent were Latino, and .2 percent were European-American*. Thirty-nine percent (358) were LEP, and 98 percent came from low-income families.

Although P.S. 1 and P.S. 42, the two sites observed by an OREA evaluation consultant were housed in old buildings (P.S.1 was built in the late 1800s), but classrooms were bright and optimally arranged for comfort and teaching ease. Classrooms were overflowing with examples of children's work. There were discrete areas for the many ongoing experiments, animals, and quiet study. Bilingual, teacher-created charts (of letters, numbers, places, etc.) covered the walls; every inch of space was utilized. Classrooms were so overcrowded that displays hung by clothespins on a line drawn from one side of the room to the other.

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* Percentages do not add up to 100 due to rounding.

STUDENT CHARACTERISTICS

Project Math and Science served a total of 630 kindergarten through sixth grade LEP students, (See Table 1). LEP status was determined by Language Assessment Battery (LAB) scores at or below the 40th percentile. Male students numbered 339 (53.8 percent) and female 291 (46.2 percent).

TABLE 1

Number of Students in Project Math and Science

SITE	GRADE							TOTAL
	K	1	2	3	4	5	6	
P.S. 1	23	30	17	27	4	4	2	107
P.S. 2	--	28	20	9	--	32	3	92
P.S. 42	40	39	26	22	3	3	--	133
P.S. 124	30	45	18	6	2	3	--	104
P.S. 130	22	28	--	32	24	30	58	194
TOTAL	115	170	81	96	33	72	63	630

A majority of the participants (50.3 percent) were born in China; the remainder were either from the United States, Hong Kong or other Asian countries. Students who had emigrated to this country had a median of one year of schooling in their native country. Most of the project participants (94.8 percent) came from low-income families and were eligible for the free-lunch program.

Needs Assessment

Before instituting Project Math and Science, C.S.D. 2 conducted a needs assessment of the targeted students, their families, and the educational staff who

were to serve them. This assessment concluded that four major needs had to be addressed: 1) staff training to ensure that classroom teachers learned and implemented the techniques, methodology, and philosophy of mathematics and science and bilingual/bicultural education and could successfully integrate them into the curriculum; 2) training for administrators and non-project teachers to facilitate the transition of LEP students into regular classes; 3) support services for students to improve performance; and 4) activities for parents to involve them in their children's education.

PROJECT OBJECTIVES

Student Objectives

- By June 30, 1993, participating LEP students will have shown improvement on the English language version of the LAB greater than that of non-project comparison group.
- By June 30, 1993, participating students will improve their English language skills as demonstrated by a significant increase in scores on the Language Assessment Battery (LAB), as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.
- By June 30, 1993, participating students will improve their English language skills as demonstrated by a significant increase in scores on the Degrees of Reading Power (D.R.P.) test, as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.
- By June 30, 1993, participating students will improve their mathematics skills as demonstrated by a significant increase in scores on the Metropolitan Achievement Test (MAT) in mathematics as measured by a correlated *t*-test for significance between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.

- By June 30, 1993, at least 75 percent of participating students will demonstrate the acquisition of high-order thinking skills related to mathematics as measured by a review of teacher logs, checklists, monthly reports, and student portfolios.

- By June 30, 1993, at least 75 percent of participating students will demonstrate a mastery of mathematics by scoring 80 percent or higher on a criterion-referenced district- or teacher-developed Chinese language mathematics test.

- By June 30, 1993, at least 75 percent of participating students will demonstrate a mastery of science by scoring 80 percent or higher on a criterion-referenced district- or teacher-developed Chinese language science test.

- By June 30, 1993, participating students will improve their science skills, as demonstrated by a significant increase in scores on the citywide standardized Science Achievement Test, as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.

- By June 30, 1993, at least 75 percent of participating students will demonstrate the acquisition of information about mathematics- and science-related education, training, and employment options, as measured by a review of teacher and student checklists.

Staff Development Objectives

- By January 1, 1993, at least 80 percent of participating teachers and paraprofessionals will have demonstrated an increased knowledge of bilingual mathematics and science content and methodology, as measured by pre- and post-training questionnaires.

- By June 30, 1993, at least 80 percent of participating teachers and paraprofessionals will have improved their ability to use project content and methodology, as measured by pre- and post-questionnaires and by structured classroom observations by the Program Director, Staff Developers, and an independent evaluator.

- By June 30, 1993, at least 80 percent of the participating teachers will find satisfactory for use with their students project-adopted curriculum, as measured by a questionnaire.

Parental Involvement Objectives

- By June 30, 1993, at least 60 percent of the parents of participating students will have taken part in three or more activities for parents, as measured by attendance records for parental involvement activities.

- By June 1993, at least 60 percent of the parents of participating students will have demonstrated a satisfactory level of understanding of and participation in their children's mathematics and science education, as measured by a parent checklist in English and Chinese and by teacher reports.

PROJECT IMPLEMENTATION

During the 1992-93 school year, Project Math and Science provided instructional and support services to 630 LEP students and their families, most of whom spoke Chinese. The project's main goals were to improve student achievement in mathematics and science while improving their English language proficiency; to develop an integrated approach to teaching mathematics and science to Chinese-speaking LEP students; and to provide activities for parents so that they would be actively involved in their children's education.

To meet these goals, the project provided E.S.L. instruction and enriched mathematics and science instruction. Classes were conducted in Chinese at the lower levels, and as students' proficiency increased, a bilingual and then an E.S.L. approach were used.

The project provided numerous staff development workshops and reimbursement to teachers who took courses at institutions of higher learning. The project also provided many parental involvement activities, including workshops, a trip to a State Association for Bilingual Education (SABE) conference, and a

newsletter. Parents were also encouraged to participate in mainstream parent activities.

Materials, Methods, and Techniques

Project Math and Science offered E.S.L. at the pre-literacy, beginning, and intermediate levels and N.L.A. at literacy to intermediate levels. Content area classes were taught using the students' native language as needed. In grades kindergarten through six, mathematics was taught using English supplemented by the students' native language. In kindergarten through second grade, science was taught in the native language supplemented with English, while grades three to six started with the native language and moved to English with an E.S.L. technique. Social studies was taught in the native language in the lower grades and English with an E.S.L. technique as the students advanced. English language arts and reading for grades kindergarten through six, computer classes for grades four and five, and music for kindergarten through grade three were all taught in English with an E.S.L. approach.

Teachers used a wide array of instructional strategies and techniques, including the whole language approach for reading; the writing process; Total Physical Response (T.P.R.) through hands-on science, cooperative learning, peer tutoring, adapted/sheltered English; and the Cognitive Academic Language Learning Approach (CALLA), a Title VII-developed strategy. For content area instruction, strategies included all the above, in addition to an integrated thematic approach.

For a list of instructional materials used in the project, see Appendix A.

Staff Qualifications

Title VII staff. Title VII funds paid the salary of one resource specialist and part of the salaries of the project director and two other resource specialists. For a description of degrees held, certification, and language competencies (teaching or communicative proficient*), see Table 2.

TABLE 2

Project Staff Qualifications

Position Title	Degree	Certificate(s)/ Licenses	Language Competence
Project Director	M.A.	Common Branches	Chinese (TP)
Resource Specialist	M.S.	Common Branches	Chinese (TP)
Resource Specialist	M.S.	Common Branches	Chinese (TP)
Resource Specialist	M.S.	Common Branches	Spanish/Italian (CP)

* Teaching proficiency (TP) is defined as the ability to use LEP students' native language in teaching language arts or other academic subjects. Communicative proficiency (CP) is defined as a non-native speaker's basic ability to communicate and interact with students in their native language.

Other staff. Tax-levy and other funds paid the salaries of 33 classroom teachers. Thirty teachers held Common Branch certification, two teachers had certification in E.S.L., and one teacher was certified in Chinese/bilingual education. Three teachers were T.P. in Chinese, two were C.P. in Chinese, and one was C.P. in German. All teachers held master's degrees.

Staff development. Staff development was one of the major components of the project. The resource specialists demonstrated lessons and materials to teachers of project students throughout the year and organized workshops. The project provided numerous staff development workshops at various locations, including local school sites and project staff also attended district workshops. Topics included alternative assessment, peer coaching, and teaching science and mathematics to LEP students.

The project offered tuition reimbursement for teachers who took education courses (bilingual, E.S.L., mathematics, science or computer science). Ten teachers took and completed a total of thirteen courses.

Project staff attended the New York State Teaching English to Speakers of Other Languages (N.Y.S. TESOL) conference as well as the National Association of Bilingual Education (NABE) conference, where they participated in workshops on mathematics, science, and bilingual education.

Instructional Time Spent on Particular Tasks

See Appendix B for examples of class schedules.

Length of Time Participants Received Instruction

Students had a mean of 1 year (s.d.=1.5) of education in a non-English-speaking school system and 1.8 years (s.d.=1.1) of education in the United States. Median participation time in Project Math and Science was 10 months.

Activities to Improve Pre-referral Evaluation Procedures for Exceptional Students

At all sites, teachers modified lessons to meet the needs of children who were gifted and talented. At P.S. 124, the Title VII funded Project BEST targeted bilingual gifted and talented children.

Students who were thought to be in need of special education services were referred by classroom teachers to the School-Based Support Team (S.B.S.T.) for evaluation. The S.B.S.T. had Chinese-speaking members at all project sites.

PARENT AND COMMUNITY INVOLVEMENT ACTIVITIES

Project staff provided many workshops for parents on topics such as teaching children at home through games, hands-on science projects, and developmental issues. After every workshop, the project provided materials for parents to take home and use with their children. Staff members also led a parent trip to the State Association for Bilingual Education (SABE) conference. The project developed, translated, and disseminated a bilingual newsletter with information, suggestions, and ideas for parents. The project also developed a manual for parents to use with their children as an educational resource after a field trip.

II. EVALUATION METHODOLOGY

EVALUATION DESIGN

Project Group's Educational Progress as Compared to That of an Appropriate Non-Project Group

OREA used a gap reduction design to evaluate the effect of language instruction on project students' performance on standardized tests. Because of the difficulty in finding a valid comparison group, OREA used instead the groups on which the tests were normed. Test scores are reported in Normal Curve Equivalents (N.C.E.s), which are normalized standard scores with a mean of 50 and a standard deviation of 21.1. It is assumed that the norm group has a zero gain in N.C.E.s in the absence of supplementary instruction and that participating students' gains are attributable to project services.

Applicability of Conclusions to All Persons Served by Project

Data were collected from all participating students for whom there were pre- and posttest scores. (There were no pretest data on students who entered the program late; therefore, posttest data for them will serve as pretest data for the following year.) Instruments used to measure educational progress were appropriate for the students involved. The LAB, Degrees of Reading Power (D.R.P.), and the Metropolitan Achievement Test for Mathematics (replaced by the California Achievement Test [CAT] in spring 1993) are used throughout New York City to assess the growth of English and mathematics skills in populations similar to those served by Project Math and Science.

INSTRUMENTS OF MEASUREMENT

OREA compared pre- and posttest scores on the LAB and/or the D.R.P. to assess the three E.S.L. objectives. To assess two of the mathematics objectives, OREA compared pretest scores on the MAT-Math and posttest scores on the Concepts and Applications subtest of the CAT.

All students were tested at the appropriate grade level. The language of the LAB was determined by the test itself, whereas the language of the MAT-Math and Math Concepts and Applications subtest of the CAT was determined by the language in which the student received instruction in mathematics.

According to the publishers' test manuals, all standardized tests used to gauge project students' progress are valid and reliable. Evidence supporting both content and construct validity is available for the LAB. Content validity is confirmed by an item-objective match and includes grade-by-grade item difficulties, correlations between subtests, and the relationship between the performance of students who are native speakers of English and students who are LEP. To support reliability, the Kuder-Richardson Formula 20 (KR20) coefficients and standard errors of measurement (SEM) are reported by grade and by form for each subtest and total test. Grade reliability coefficients, based on the performance of LEP students on the English version, ranged from .88 to .96 for individual subtests and from .95 to .98 for the total test.

Evidence is available to support the validity of the D.R.P. The D.R.P. is an objective-referenced test, with the single outcome objective being the comprehension

of expository English text. Criterion validity of the D.R.P. is demonstrated by the presence of a correlation (r=.90) with results from a criterion-referenced instrument, the Word Completion Test. To support reliability, the KR20 coefficients and SEM are reported by grade. Reliability coefficients ranged from .91 to .97 for students in the second through the tenth grade; the SEM ranged from 2.6 to 3.8 raw score units.

For the Math Concepts and Applications Subtest of the CAT, content validity was determined by comparing the content descriptions and the test items with particular curriculum objectives. The KR20 was used as a measure of internal consistency. The SEM is also reported in order to indicate the range within which students' true scores are likely to fall. For the Math Concepts and Applications subtest given in second through eighth grade, the number of items ranged from 42 to 50. KR20 coefficients ranged from 0.88 to 0.91; SEM ranged from 2.55 to 3.09 raw score units.

OREA used final course grades to assess the third mathematics objective and two science objectives, as specified.

To assess the objectives for the ongoing education of teachers, OREA developed and distributed Likert-type evaluation questionnaires and/or staff development surveys for teachers to rate the quality, relevance, and usefulness of staff development activities (see Appendix C).

In order to assess one parental involvement objectives, OREA developed and used a Likert-type questionnaire and/or parent involvement surveys (see Appendix C).

DATA COLLECTION AND ANALYSIS

Data Collection

To gather qualitative data, an OREA evaluation consultant carried out on-site and telephone interviews with the project director several times during the school year, and also observed two classes on each of two visits. The project evaluator collected the data and prepared the final evaluation report in accordance with the New York State E.S.E.A. Title VII Bilingual Education Final Evaluation Report format, which was adapted from a checklist developed by the staff of the Evaluation Assistance Center (EAC) East in consultation with the Office of Bilingual Education and Minority Language Affairs (OBEMLA).

Proper Administration of Instruments

Qualified personnel received training in testing procedures and administered the tests. Test administrators followed guidelines set forth in the manuals accompanying standardized tests. Time limits for subtests were adhered to; directions were given exactly as presented in the manual.

Testing at Twelve-Month Intervals

Standardized tests were given at 12-month intervals, following published norming dates.

Data Analysis

Accurate scoring and transcription of results. Scoring, score conversions, and data processing were accomplished electronically by the Scan Center of the Board of Education of the City of New York. Data provided by the Scan Center were analyzed

in the Bilingual, Multicultural, and Early Childhood Evaluation Unit of OREA. Data collectors, processors, and analysts were unbiased and had no vested interest in the success of the project.

Use of analyses and reporting procedures appropriate for obtained data. To assess the significance of students' achievement in English and mathematics, OREA computed a correlated *t*-test on the LAB, D.R.P., and MAT-Math/CAT N.C.E. scores. The *t*-test determined whether the difference between the pre- and posttest scores was significantly greater than would be expected from chance variation alone.

The only possible threat to the validity of any of the above instruments might be that LAB norms were based on the performance of English Proficient (EP) rather than LEP students. Since OREA was examining gains, however, this threat was inconsequential—the choice of norming groups should not affect the existence of gains.

III. FINDINGS

PARTICIPANTS' EDUCATIONAL PROGRESS

Project Math and Science carried out all instructional activities specified in its original design. Throughout the school year, students had ample opportunity to develop their English, mathematics, and science skills.

LEP Participants' Progress in English

The evaluation objectives for English development were:

- By June 30, 1993, participating LEP students will have shown improvement on the English language version of the LAB greater than that of a non-project comparison group.
- By June 30, 1993, participating students will improve their English language skills as demonstrated by a significant increase in scores on the Language Assessment Battery (LAB), as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.

There were complete pre- and posttest scores on the LAB for 523 students from kindergarten through grade six. (See Table 3.) Students showed a mean gain of 13.1 N.C.E.s, which was statistically significant ($p<.05$) and higher than the previous year's 7.5 N.C.E.s.

The project met both E.S.L. objectives for English language proficiency.

TABLE 3

Pretest/Posttest N.C.E. Differences on the
Language Assessment Battery

School Site	Total number of project students	Number of students for whom data were available	Pretest		Posttest		Difference		*t* value
			Mean	S.D.	Mean	S.D.	Mean	S.D.	
P.S. 1	107	88	18.0	13.1	25.2	15.2	7.1	12.4	5.42*
P.S. 2	92	80	10.7	11.3	19.6	16.7	8.9	10.9	7.26*
P.S. 42	133	107	10.4	12.5	26.3	19.1	15.8	19.6	8.35*
P.S. 124	104	97	14.9	13.7	31.5	20.4	16.6	20.0	8.18*
P.S. 130	194	151	10.8	12.2	25.4	23.7	14.6	21.6	8.31*
Total	630	523	12.7	12.9	25.8	20.1	13.1	18.5	16.18*

*$p < .05$

- Students at every site and overall made significant gains on the LAB.

- By June 30, 1993, participating students will improve their English language skills as demonstrated by a significant increase in scores on the Degrees of Reading Power (D.R.P.) test, as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.

Only those students that have been in an English-speaking school system for at least two years take the D.R.P. test. Of the project participants, complete pre- and posttest scores on the D.R.P. were available for 29 students in grades two through six. (See Table 4.) Students showed a mean gain of 7.1 N.C.E.s, which was statistically significant ($p<.05$) and higher than the previous year's 1.14 N.C.E.s.

The project met its E.S.L. reading objective, which it failed to do in the previous year.

Participants' Progress in Native Language Arts

Project Math and Science did not propose an N.L.A. objective. However, the project provided students with N.L.A. instruction at the literacy through intermediate levels five periods each week. (See Appendix A for instructional materials used.)

LEP Participants' Academic Achievement

Mathematics. In a double-period mathematics class observed by an OREA field consultant, the lesson was on comparisons: ***greater than/less than/equal to***. The teacher first showed the relationships between numbers on an abacus, thereby contextualizing and visually presenting difficult concepts. Answers to questions were written on the board with symbols (>,<,=), while the teacher modeled the appropriate language. The teacher provided guide questions, leading the students

TABLE 4

Pretest/Posttest Differences on the
Degrees of Reading Power Test, by Site

School Site	Total number of project students	Number of students for whom data were available	Pretest		Posttest		Difference		*t* value
			Mean	S.D.	Mean	S.D.	Mean	S.D.	
P.S. 1	107	7	31.4	19.0	36.9	26.7	5.4	18.9	0.76
P.S. 2	92	2	10.5	13.4	7.0	8.5	-3.5	5.0	-1.00
P.S. 42	133	--	--	--	--	--	--	--	--
P.S. 124	104	3	11.7	4.2	10.7	4.0	-1.0	8.2	-0.21
P.S. 130	194	10	22.0	10.0	40.3	14.7	18.3	9.1	6.36*
Total	630	29	20.2	13.7	27.3	20.7	7.1	14.1	2.70*

*$p<.05$

- Overall, gains on the D.R.P. were significant.

to discover the answer for themselves. After the class had completed a few examples in this fashion, the teacher picked students to go to the board, use the abacus, and so act as teacher. The students were very excited and eager throughout the lesson. Students then worked in groups using chips to visualize comparisons. The students had an assignment sheet to complete.

The project proposed three objectives for mathematics:

- By June 30, 1993, participating students will improve their mathematics skills as demonstrated by a significant increase in scores on the Metropolitan Achievement Test (MAT) in mathematics, as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.

As the Metropolitan Achievement Test (MAT) was not used in 1992-93, OREA used scores on the 1991-92 MAT as a pretest and scores on the California Achievement Test (CAT) as a posttest. Scores were available for 32 students in grades two through six. (See Table 5.) Project students showed a mean gain of 7.5 N.C.E.s (s.d.=18.0), which was statistically significant ($p<.05$) but lower than the previous year's gain of 9.46 N.C.E.s.

As it had done last year, the project met its objective for the development of skills in mathematics as measured by the MAT-Math.

TABLE 5

Pretest/Posttest N.C.E. Differences on the
Metropolitan Achievement Test in Mathematics (MAT-Math) and
California Achievement Test (CAT), by Site

School Site	Total number of project students	Number of students for whom data were available	Pretest		Posttest		Difference		*t* value
			Mean	S.D.	Mean	S.D.	Mean	S.D.	
P.S. 1	107	7	44.0	16.0	53.6	28.0	9.6	18.0	1.41
P.S. 2	92	6	47.0	29.9	38.3	22.5	-8.7	19.6	-1.08
P.S. 42	133	--	--	--	--	--	--	--	--
P.S. 124	104	3	17.0	14.7	32.0	8.0	15.0	14.2	1.83
P.S. 130	194	10	50.2	17.2	61.8	24.2	11.6	21.2	1.73
Total	630	32	42.2	21.2	49.7	23.8	7.5	18.9	2.25*

*$p<.05$

- Overall, students showed significant gains in mathematics.

- By June 30, 1993, at least 75 percent of participating students will demonstrate the acquisition of high-order thinking skills related to mathematics, as measured by a review of teacher logs, checklists, monthly reports, and student portfolios.

The project did not provide OREA with the materials postulated to measure this objective. Therefore, OREA compared pre- and posttest scores on standardized tests, as it had under these same circumstances when used. Last, the MAT-Math was used to assess this objective. This year, the MAT-Math was used for pretest scores and the CAT for posttest scores. Of the 32 students for whom these data were available, 19 (59.4 percent) showed a gain.

The project did not meet its objective for development of high order thinking skills related to mathematics. Last year, the project met this objective.

- By June 30, 1993, at least 75 percent of participating students will demonstrate a mastery of mathematics by scoring 80 percent or higher on a criterion-referenced district- or teacher-developed Chinese language mathematics test.

Since there were no district- or teacher-developed Chinese language mathematics tests, OREA used final course grades to evaluate this objective. Of 621 students for whom data were reported, 519 (83.6 percent) scored 80 percent or higher.

The project met its objective for mastery of mathematics, as it did in the previous year.

Science. An OREA evaluation consultant observed two science classes. The first lesson was about paths of electricity and the students were involved in a hands-on experiment using batteries, wire, a nail, and paper clips. Working in groups of two, they tried to answer the focus question, "What happens when I wind the wire touching the batteries around the nail 5 times (10 times, 15 times)?" The teacher walked around the classroom assisting individual students. Students shouted out answers in their enthusiasm as they saw results and wanted to experiment further. Toward the end of the class, each group wrote a report summarizing its findings. After they handed in the summaries, the class as a whole summarized its findings. In another science class observed by the OREA consultant, students were conducting hands-on experiments with mealworms. Both lessons were not only highly successful academically, but they kept students' motivation at peak levels.

The project had two objectives for science:

- By June 30, 1993, at least 75 percent of participating students will demonstrate a mastery of science by scoring 80 percent or higher on a criterion-referenced district- or teacher-developed Chinese language science test.

Since there was no Chinese-language science test, OREA used final course grades to assess this objective. Of the 621 students for whom data were reported, 492 (79.2 percent) received final grades of 80 percent or higher.

The project met its science mastery objective, as it did in the previous year.

- By June 30, 1993, participating students will improve their science skills, as demonstrated by a significant increase in scores on the citywide standardized Science Achievement Test, as measured by a correlated *t*-test for significance of difference between pre- and posttest scores converted into Normal Curve Equivalent (N.C.E.) units.

OREA was unable to assess this objective as proposed since the Science Achievement Test is only administered once in the spring to fourth graders and, therefore, impossible to use for making pretest/posttest comparisons. Because of this, the objective was not evaluated last year either.

Career Awareness

- By June 30, 1993, at least 75 percent of participating students will demonstrate the acquisition of information about mathematics- and science-related education, training, and employment options, as measured by a review of teacher and student checklists.

There were complete data for 332 project students. Of these, 330 (99.4 percent) demonstrated increased career awareness.

The project met its career awareness objective, as it did in the previous year.

FORMER PARTICIPANTS' PROGRESS IN ENGLISH LANGUAGE CLASSROOMS

The project did not report that any students had been mainstreamed in the previous year.

OVERALL EDUCATIONAL PROGRESS ACHIEVED THROUGH PROJECT

Mainstreaming

The project mainstreamed two students (0.3 percent) in the year under review.

Grade Retention

Project Math and Science did not propose any objectives for grade retention. As in the previous year, no project students were retained in grade.

Attendance

The project did not propose any objectives for attendance. The overall project attendance rate for the year under review was 97.3 percent. This was a decrease from the previous year's 98.1 percent but still slightly higher than the mainstream attendance rate of 97.2 percent.

Placement in Gifted and Talented Programs

The project offered special computer programs to students who were gifted and talented.

STAFF DEVELOPMENT OUTCOMES

The project proposed three staff development objectives:

- By January 1, 1993, at least 80 percent of participating teachers and paraprofessionals will have demonstrated an increased knowledge of bilingual mathematics and science content and methodology, as measured by pre- and post-training questionnaires.

Project Math and Science distributed a Likert-type evaluation questionnaire to project staff and submitted 27 completed questionnaires to OREA. (See Appendix C.) Twenty-three (85 percent) of the respondents indicated increased knowledge of the bilingual mathematics and science curriculum. Twenty-six (96 percent) indicated increased knowledge of methodology for teaching bilingual mathematics and science.

The project met its objective for increasing knowledge of bilingual mathematics and science curricula and methodologies, as it did in the previous year.

- By June 30, 1993, at least 80 percent of participating teachers and paraprofessionals will have improved their ability to use project content and methodology, as measured by pre- and post-questionnaires and by structured classroom observations by the Program Director, Staff Developers, and an independent evaluator.

Of the 27 completed Likert-type evaluation questionnaires received by OREA, 25 (93 percent) of the respondents indicated that their ability to use project content and methodology had improved. (See Appendix C for the questionnaire.)

The project met its objective for improvement in staff ability, as it did in the previous year.

- By June 30, 1993, at least 80 percent of the participating teachers will find satisfactory for use with their students project-adapted curriculum, as measured by a questionnaire.

Of the 27 completed Likert-type evaluation questionnaires received by OREA, 26 (96 percent) of the teachers indicated that they found the project-adapted curriculum satisfactory. (See Appendix C for questionnaire.)

The project met its objective for staff satisfaction with curriculum, as it did in the previous year.

CURRICULUM DEVELOPMENT OUTCOMES

Although the project did not propose any objectives in this area, project staff did develop certain curriculum materials. The project adapted and translated lesson plans in science and mathematics, translated the dental health unit of the

science/health curriculum, adapted a bubble science unit, and developed science kits for LEP students.

PARENTAL INVOLVEMENT OUTCOMES

The project proposed two objectives for parental involvement.

- By June, 1993, at least 60 percent of the parents of participating students will have taken part in three or more activities for parents, as measured by attendance records for parental involvement activities.

The project offered parents of participating students a wide variety of activities, including meetings, workshops, and a trip to a SABE conference. The project encouraged parents to attend all mainstream parental activities. A project-developed bilingual newsletter also advocated parental participation.

OREA was unable to assess the objective for parental attendance, however, because the project did not provide specific attendance records.

- By June 1993, at least 60 percent of the parents of participating students will have demonstrated a satisfactory level of understanding of and participation in their children's mathematics and science education, as measured by a parent checklist in English and Chinese and by teacher reports.

Parents received an OREA-developed questionnaire in English and Chinese to assess their understanding of and participation in their children's mathematics and science education. (See Appendix C.) Of the 332 parent questionnaires received by OREA, at least 94 percent indicated that their understanding of and participation in their child's mathematics and science education had increased.

The project met its objective for parental understanding of and participation in their child's mathematics and science education.

IV. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

ACHIEVEMENT OF OBJECTIVES

Project Math and Science met its three objectives for E.S.L., two of three mathematics objectives, and one of two science objectives. The project also met its objective for career awareness, three objectives for staff development, and one of two objectives for parental involvement. The project did not meet its objective for the development of high-order thinking skills related to mathematics. OREA could not measure one objective for the development of science skills or for parental attendance because the project did not provide the necessary data.

Participating students in Project Math and Science showed academic progress in the year under review: all 630 students were promoted to the next grade. The LEP population improved their English language proficiency and their skills in mathematics and science as indicated by their performance on the LAB, D.R.P., MAT-Math/CAT, and their final course grades.

MOST AND LEAST EFFECTIVE COMPONENTS

Highly effective components of Project Math and Science were E.S.L., science instruction, staff development, and parental involvement. Quantitative data and reports of observers and those involved in the program attest to the strength shown in these areas. The project director suggested that increased staffing, the assignment of resource specialists to just one school rather than various schools, and

increased time for meetings between target teachers and resource specialists would increase the project's effectiveness.

Project services not only benefited the students academically but also increased awareness of their own and other cultures. Teachers of participating students improved their teaching techniques through numerous workshops. Parents of participants benefited from the broad array of activities that the project offered throughout the year.

Performance on the CAT was disappointing, although OREA observations of classes indicated high student motivation and hands-on activities in mathematics.

RECOMMENDATIONS TO ENHANCE PROJECT EFFECTIVENESS

- Explore additional techniques to increase students' acquisition of skills in mathematics, possibly by expanding peer tutoring and enrichment programming.
- Provide OREA with the attendance data necessary to fully evaluate all objectives.

APPENDIX A

Instructional Materials

English as a Second Language

Grade	Title	Author	Publisher	Date of Publication
Teacher's Resource	E.S.L. Teacher's Book of Lists	Jacqueline E. Kress	Center for Applied Research in Education	1993
K-3	Life on Earth	*	Greenshower	1990
K-3	The Four Seasons	*	Greenshower	1990
K-3	The Four Senses	*	Greenshower	1990
K-3	The Four Elements	*	Greenshower	1990
K-6	Jazz Chants Fairytales	Carolyn Graham	Oxford	*
1-6	Jazz Chants for Children	Carolyn Graham	Oxford	*
K-6	Trade Books - Literature	various	Rigby, Scholastic Inc., Modern Curriculum Press, Wright Group	*
4-5	Open Sesame Series (Assorted Levels & Components	various	Oxford	1983
4-6	Sesame Street Dictionary	Jill Wagner	Oxford	1983
4,5	Steps to English 1, 2, 3, 4, 5	Doris Kernan	McGraw Hill	1983
5,6	Yes! English for Children (Books C, D, E)	Michael Walker	Addison-Wesley	1983
6	Tone into English	Vive Kind	Regents	1980
6	Hello English	Barbara Zaffran	National Textbook Co.	1988

* not submitted

APPENDIX A

Instructional Materials, cont'd.

Native Language Arts

Grade	Title	Author	Publisher	Date of Publication
K-3	Chinese Literature Book	*	*	1992
3-6	Chinese Science Series	*	*	1971
K-6	Explorer Center Pack (Chinese)	*	Scott Foresman	1992
K-6	various video storybooks	*	*	*
K-6	Children's Songbook (1 & 2)	*	Chi Sheng Book Co. (Hong Kong)	1984
K-6	Folkstories	L. Chao, Editor	Overseas Chinese Affairs Commission	1985
K-6	Chinese Fables	Tung Chung	Overseas Chinese Affairs Commission	1985
K-6	Chinese/English Dictionary	*	*	

Social Studies

Grade	Title	Author	Publisher	Date of Publication
4,5	Our People & Their Stories	Nancy Susan Dunetz	Addison-Wesley	1990
4-6	N.Y. Past & Present	*	Noble & Noble	1967
5,6	Eastern Hemisphere	*	Scott Foresman	1986
K-6	N.Y. Newsday (Newspaper)			

* not submitted

APPENDIX A

Instructional Materials

Mathematics

Grade	Title	Author	Publisher	Date of Publication
K-2	Mathematics This Way	Mary Baratta Lorton	Addison-Wesley	*
1	Heath Mathematics	W.E. Rucker & Others, Heath Co.	Modern Curriculum Press	1985
2	Literature First	W.E. Rucker & Others, Heath Co.	Modern Curriculum Press	1985
3	Heath Mathematics	W.E. Rucker & Others Heath Co.	Modern Curriculum Press	1985
4,5	Mathematics Today	Tanet Abott	Harcourt Brace	1987
1-3	A Collection Of Math Lessons	Marilyn Burns & Bonnie Frank	The Math Solution Publication	1988
4-6	A Collection of Math Lessons	Marilyn Burns & Bonnie Frank	The Math Solution Publication	1988
4-6	Heath Mathematics	W.E. Rucker & Others, Heath Co.	Modern Curriculum Press	1985
6	New Ways in Numbers	*	Heath & Co.	1979
6	Math Today	*	Harcourt, Brace, Jovanovich	1986
K-6	AIMS- Adventures In Math and Science	*	AIMS Educational Foundation	1987
*	Progress in Math	D. Gundlack, K. Buffie	Laidlow Bros.	*
*	Chinese Mathematics	*	Evaluation, Dissemination, & Assessment Center	*
*	Game 24	R. Sun	Suntex International	*

* not submitted

Note: Mathematics (all grades) used hands-on materials such as attribute blocks, Ge boards, learning links, pattern blocks, play money, sorting toys and trays, and other materials.

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APPENDIX A

Instructional Materials

Science

Grade	Title	Author	Publisher	Date of Publication
K-2	Explorers in Science (3 volumes)	B. Coombs, L. Harcourt, J. Travis, & N. Wannamaker	Addison-Wesley	1989
K-2	ABC Adventures Themes (series)	assorted	Troll	*
K-2	Now I Know (Series)	assorted	Troll	*
1	Heath Science	Barufaldi, Ladd, Moses	D.C. Heath & Co.	1984
K-3	Science Place Program (Thematic Kits)	assorted	Scholastic	1992
3	HBA Science	Cooper, Blackwood, Bueschen, Giddings, Acarin	H.B.J.	1985
4,5	Holt Science	J. Abrus Cats & Others	Holt, Rinehart, & Winston	1989
6	Science	*	Winston Publishing	1986
K-6	Explorer Center Pack	*	Scott Foresman	1992
1-6	Discover the Wonder	*	Scott Foresman	1992
1-6	Explorer's Activity Guide	*	Scott Foresman	1992
K-6	Holt Science	Abruscato, Fossalece	Holt, Rinehart, Winston	1986
K-6	Teacher developed or adapted materials			

* not submitted

NOTE: Hands-on science materials (moth cocoons, larvae, viewing cages, magnets, scales, beakers, planting materials, sound kits, senses kits, glycerine, dishwashing detergent, plastic pans, prisms, magnifying glasses, thermometers, and bug boxes, etc.) were also used.

APPENDIX B

Class Schedules

First Grade, P.S. 42

Time	Monday		Tuesday		Wednesday		Thursday		Friday	
	Subject	Language	Subject	Language	Subject	Language	Subject	Language	Subject	Language
8:40	E.S.L.	English	E.S.L.	English	E.S.L.	English	E.S.L.	English	E.S.L.	English
9:25	Preparation	Preparation	Reading	English/ Chinese	Preparation	Preparation	Reading	English/ Chinese	Preparation	Preparation
10:10	Reading	English/ Chinese	Reading	English/ Chinese	Reading	English/ Chinese	Reading	English/ Chinese	Reading	English/ Chinese
10:55	Reading	English/ Chinese	Writing	English/ Chinese	Reading	English/ Chinese	Preparation	Preparation	Reading	English/ Chinese
11:40	LUNCH		LUNCH		LUNCH		LUNCH		LUNCH	
12:35	Math	English/ Chinese	Math	English/ Chinese	Math	English/ Chinese	Math	English/ Chinese	Math	English/ Chinese
1:30	Social Studies	English/ Chinese	Language Arts	English/ Chinese	Art	English/ Chinese	Social Studies	English/ Chinese	Writing	English/ Chinese
2:15	N.L.A.	Chinese	Preparation	Preparation	N.L.A.	Chinese	Language Arts	English/ Chinese	N.L.A.	Chinese

APPENDIX B

Class Schedules, cont'd.

Third and Fourth Grade, P.S. 2

Time	Monday		Tuesday		Wednesday		Thursday		Friday	
	Subject	Language	Subject	Language	Subject	Language	Subject	Language	Subject	Language
8:40	Basic English	English/ Chinese								
9:35	Reading	English/ Chinese	Bilingual Assembly	English	Preparation	Preparation	Reading	English/ Chinese	Preparation	Preparation
10:25	E.S.L.	English	Spelling Test	English	Reading	English/ Chinese	Reading	English/ Chinese	Reading	English/ Chinese
11:05	Reading	English/ Chinese								
11:55	LUNCH		LUNCH		LUNCH		LUNCH		LUNCH	
12:40	Math	English/ Chinese								
1:35	N.L.A.	Chinese	N.L.A.	Chinese	Health Education	Chinese	Social Studies	Chinese	Science	Chinese
2:20	Stories	English/ Chinese								

APPENDIX B

Class Schedules, cont'd.

Fifth Grade, P.S. 2

Time	Monday		Tuesday		Wednesday		Thursday		Friday	
	Subject	Language	Subject	Language	Subject	Language	Subject	Language	Subject	Language
8:40	Reading		Reading		Reading		Reading		Reading	
9:25	E.S.L.		Bilingual Assembly		Science	Chinese	Science	Chinese	Science	Chinese
10:15	Social Studies	Chinese	Social Studies	Chinese	Social Studies	Chinese	Social Studies	Chinese	Social Studies	Chinese
11:00	Math	Chinese	Math	Chinese	Physical Education	Chinese	Math	Chinese	Math	Chinese
11:45	LUNCH		LUNCH		LUNCH		LUNCH		LUNCH	
12:40	Journal		Writing		Writing		N.L.A.	Chinese	N.L.A.	Chinese
1:25	E.S.L.		E.S.L.		E.S.L.		E.S.L.		E.S.L.	
2:10	N.L.A.	Chinese	N.L.A.	Chinese	N.L.A.	Chinese	Computer		Computer	

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APPENDIX C

PARENT QUESTIONNAIRE

Program: **Chinese Bilingual Math and Science** 9 4 (1 2)

Directions: Please write "Y" for Yes and "N" for No in the boxes at the right.

1. Has participating in the Chinese Bilingual Math and Science Program helped you to understand your child's mathematics education? ☐ (3)

2. Has participating in the Chinese Bilingual Math and Science Program helped you to understand your child's science education? ☐ (4)

3. As a result of the Chinese Bilingual Math and Science Program, have you participated more in your child's mathematics education? ☐ (5)

4. As a result of the Chinese Bilingual Math and Science Program, have you participated more in your child's science education? ☐ (6)

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

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APPENDIX C

Program: **Chinese Bilingual Math and Science**

當您回答"是"時,請在右边空格中填入"Y";當回答"不是"時,請填入"N".

1. 数学和科学中文双語課程的活動是否有助於您对孩子的数学教育的理解? ☐ 4

2. 数学和科学中文双語課程的活動是否有助於您对孩子的科学教育的理解? ☐ 5

3. 数学和科学中文双語課程的活動是否促進您更多地參預您孩子的数学教育? ☐ 6

4. 数学和科学中文双語課程的活動是否促進您更多地參預您孩子的科学教育? ☐ 7

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APPENDIX C

STAFF DEVELOPMENT QUESTIONNAIRE

9	4
1	2

Program: **Chinese Bilingual Math and Science**

Directions: Please write "Y" for Yes, "N" for No in the boxes at the right.

1. As a result of participating in the Chinese Bilingual Math and Science Program, have you increased your knowledge of the bilingual mathematics and science curriculum? ☐ 3

2. Has your knowledge of the methodology of teaching bilingual mathematics and science increased? ☐ 4

3. Has your ability to teach mathematics and science in a bilingual classroom increased? ☐ 5

4. Are you satisfied with using hands-on manipulatives in teaching bilingual mathematics and science? ☐ 6

THANK YOU FOR COMPLETING THIS QUESTIONNAIRE.

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APPENDIX C

STUDENT ASSESSMENT

Program: **Chinese Bilingual Math and Science**

9	4
1	2

Student's Name_____

1. Please list three jobs or careers related to <u>science</u>.

   a._____

   b._____

   c._____

1b. What education or training do you need for each science-related job or career?

   a._____

   b._____

   c._____

2. Please list three jobs or careers related to <u>math</u>.

   a._____

   b._____

   c._____

2b. What education or training do you need for each math-related job or career?

   a._____

   b._____

   c._____